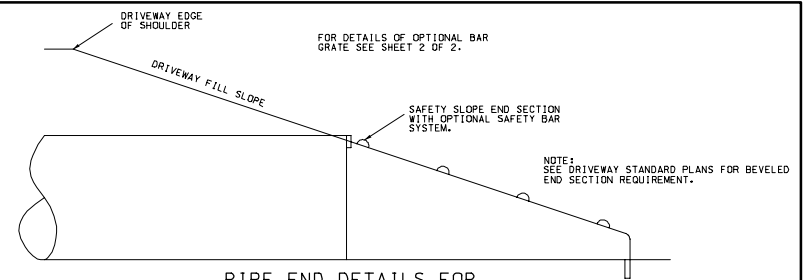


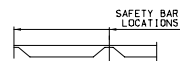
FRONT VIEW CIRCULAR PIPE

SIDE ELEVATION CIRCULAR SECTION

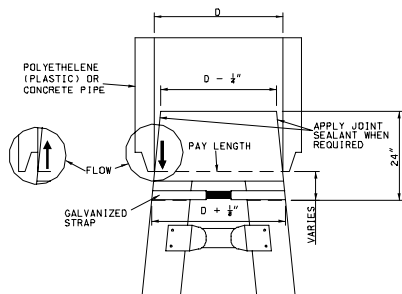
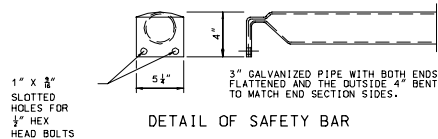
- ① FOR CROSSROAD DRAINAGE STRUCTURES ONLY.
- ② FOR PARALLEL DRAINAGE STRUCTURES ONLY.
- ③ 4" TO 6" MINIMUM
- ④ SAFETY BARS MUST BE PROVIDED UNTIL THE LATERAL SPAN OF THE OPENING IS LESS THAN OR EQUAL TO 30".



PIPE END DETAILS FOR PARALLEL DRAINAGE STRUCTURES (DRIVEWAYS)  
(SINGLE PIPE INSTALLATION)

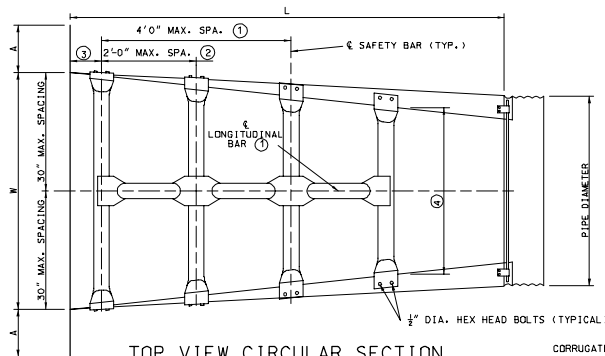


LONGITUDINAL BAR DETAIL



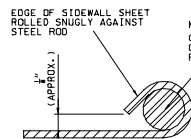
TAPERED SLEEVE FOR CONNECTION FOR CONCRETE, OR CORRUGATED POLYETHELENE PIPE

NOTE: TAPERED SLEEVE TO BE FIRMLY WEDGED INTO PIPE END BEFORE BACKFILLING PIPE PAY LENGTH.

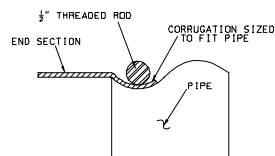


TOP VIEW CIRCULAR SECTION

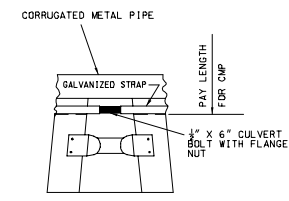
LONGITUDINAL BAR, WHEN REQUIRED, TO BE WELDED TO SAFETY BARS TO FORM SINGLE GRATE STRUCTURE. LONGITUDINAL BAR IS NOT TO BE USED FOR PARALLEL DRAINAGE STRUCTURES.  
SAFETY BARS ARE TO BE USED ON CROSSROAD DRAINAGE STRUCTURES WHEN LONGITUDINAL BAR IS SPECIFIED.



SECTION A-A

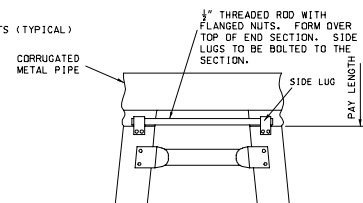


SECTION B-B



FOR 15" THRU 24" PIPE

TYPE #1 CONNECTOR DETAIL



FOR 30" AND LARGER ROUND PIPES

TYPE #2 CONNECTOR DETAIL

#### GENERAL NOTES:

END SECTIONS INCLUDING ALL BOLTS, NUTS, RODS AND STRAPS SHALL BE FABRICATED FROM GALVANIZED STEEL MEETING THE REQUIREMENTS OF SECTION 1020 THE STANDARD SPECIFICATIONS.

ALL BOLTS UNLESS OTHERWISE SHOWN SHALL BE A307 BOLTS.

WHEN REQUIRED, OPTIONAL TOE PLATE EXTENSION SHALL BE PUNCHED OR DRILLED AND BOLTED TO END SECTION TOE PLATE. STEEL FOR TOE PLATE EXTENSION SHALL BE SAME GAUGE AS END SECTION. DIMENSIONS SHALL BE OVERALL WIDTH LESS 6" BY 8" HIGH.

ATTACHMENT TO CIRCULAR PIPES 15" THROUGH 24" DIAMETER SHALL BE MADE WITH TYPE #1 STRAPS. ALL OTHER SIZES SHALL BE ATTACHED WITH TYPE #2 CONNECTORS.

SAFETY BARS AND LONGITUDINAL BARS SHALL BE FABRICATED FROM STEEL PIPE MEETING THE REQUIREMENTS OF ASTM A-53 SCHEDULE 40 SPECIFICATIONS. SAFETY BARS AND LONGITUDINAL BARS SHALL BE HOT DIPPED GALVANIZED AFTER FABRICATION IN ACCORDANCE WITH SECTION 1020 OF STANDARD SPECIFICATIONS.

INSTALLATION SHALL BE PERFORMED IN ACCORDANCE WITH SECTION 725 AND 732 OF THE STANDARD SPECIFICATIONS.

SLOTTED HOLES FOR SAFETY BAR ATTACHMENT SHALL BE PROVIDED FOR ALL END SECTIONS.

MINOR VARIATIONS OF DETAIL WILL BE ACCEPTED TO PERMIT THE USE OF A MANUFACTURER'S STANDARD METHODS OF FABRICATION.

END SECTIONS FABRICATED FROM THICKER METAL THAN INDICATED WILL BE ACCEPTED.

SAFETY BARS ARE OPTIONAL FOR PIPES WITH DIAMETERS OF LESS THAN 24".

ALL PIPES WITH DIAMETERS GREATER THAN 21" CONSTRUCTED WITHIN THE 10:1 APPROACH SLOPE OF ANY BULLNOSE GUARDRAIL SYSTEM SHALL HAVE SAFETY SLOPE END SECTION PROTECTION.

ALL BOLTS SHALL BE 3/4" DIAMETER AND GALVANIZED, UNLESS OTHERWISE SHOWN.

SKIRT SECTION IS DEFINED AS THE FLARED PORTION OF THE END SECTION INCLUDING SIDE AND BOTTOM (CENTER) PANELS AND APRON.

SKIRT SECTION FOR 12" THROUGH 24" PIPES SHALL BE MADE IN ONE PIECE.

SKIRT SECTIONS FOR 30" AND LARGER PIPES MAY BE MADE FROM UP TO 2 SHEETS JOINED BY RIVETING OR BOLTING ON CENTERLINE.

SKIRT SECTIONS FROM 48" AND LARGER PIPES MAY BE MADE FROM UP TO 3 SHEETS JOINED BY RIVETING OR BOLTING EQUAL DISTANCE FROM CENTERLINE.

ALL 3 PIECE SKIRTS FOR 60" PIPES SHALL HAVE 0.109" THICK SIDES AND 0.138" THICK BOTTOM (CENTER) PANELS. WIDTH OF BOTTOM PANELS SHALL BE GREATER THAN 20% OF THE PIPE PERIPHERY CONNECTOR SECTION. CORNER PLATES AND TOE PLATES SHALL BE GALVANIZED AND OF THE SAME OR GREATER THICKNESS AS THE SKIRT.

METAL END SECTIONS FOR CIRCULAR PIPES												
PIPE DIA. (IN.)	MIN. GAUGE ENDS (TYP.) 4:1 & 6:1	MIN. GAUGE ENDS (TYP.) 10:1	DIMENSIONS IN INCHES					L DIMENSIONS				
			A	B	C	OVERALL WIDTH	SLOPE	LENGTH (IN.)	SLOPE	LENGTH (IN.)	SLOPE	LENGTH (IN.)
			1' TOL.	1' TOL.	2' TOL.							
15 ***	16	12	8	6	21	37	4:1	20	6:1	30	10:1	70
18 ***	16	12	8	6	24	40	4:1	32	6:1	48	10:1	100
21 ***	16	12	8	6	27	43	4:1	44	6:1	66	10:1	130
24	16	12	8	6	30	46	4:1	56	6:1	84	10:1	160
30	12		12	9	36	60	4:1	80	6:1	120		
36	12		12	9	42	66	4:1	104	6:1	156		
42	12		16	12	48	80	4:1	128	6:1	192		
48	12		16	12	54	86	4:1	152	6:1	228		
54	12		16	12	60	92	4:1	176	6:1	264		
60	12		16	12	66	98	4:1	200	6:1	300		

\*\*\* NO SAFETY SLOPE END SECTION REQUIRED FOR SINGLE PIPE INSTALLATION WITH PIPES 21 INCH DIAMETER OR LESS.

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

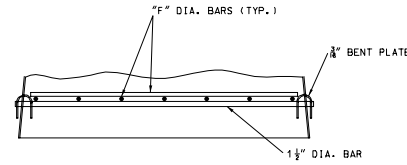
SAFETY SLOPE END SECTION

DATE: _____	EFFECTIVE: 04-01-2003	732.10E	1 2
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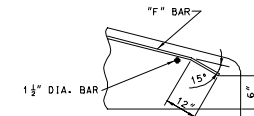
# BAR GRATE SYSTEM DATA

DRAIN PIPE SIZE	3:1 SLOPE									4:1 SLOPE									6:1 SLOPE								
	A	B	C	D	E	"F" BARS	G	H	J	A	B	C	D	E	"F" BARS	G	H	J	A	B	C	D	E	"F" BARS	G	H	J
15"																											
18"																											
21"																											
24"	0	4	2'-0"	6"	15"	$\frac{3}{4}$ "	8 $\frac{1}{2}$ "	3'-3"	18.4*	0	4	2'-0"	15 $\frac{3}{4}$ "	15"	$\frac{3}{4}$ "	12"	3'-3"	14*	2	4	2'-0"	13 $\frac{1}{4}$ "	15"	$\frac{3}{4}$ "	12"	3'-3"	9.5*
30"	0	5	2'-6"	15 $\frac{1}{2}$ "	18"	$\frac{3}{4}$ "	12"	3'-9"	18.4*	1	5	2'-6"	16 $\frac{1}{2}$ "	18"	$\frac{3}{4}$ "	12"	3'-9"	14*	3	5	2'-6"	19 $\frac{3}{8}$ "	18"	$\frac{3}{4}$ "	12"	3'-9"	9.5*
36"	1	6	3'-0"	16 $\frac{1}{2}$ "	18"	$\frac{3}{4}$ "	12"	4'-3"	18.4*	2	6	3'-0"	18"	18"	$\frac{3}{4}$ "	17 $\frac{1}{2}$ "	4'-3"	14*	5	6	3'-0"	20 $\frac{1}{4}$ "	18"	$\frac{3}{4}$ "	12"	4'-3"	9.5*
42"	2	7	3'-6"	17 $\frac{1}{2}$ "	18"	1"	12"	4'-9"	18.4*	4	7	3'-6"	12"	18"	1"	12"	4'-9"	14*	7	7	3'-6"	11 $\frac{1}{2}$ "	18"	1"	9"	4'-9"	10.1*
48"	3	8	4'-0"	18"	18"	1"	12 $\frac{1}{2}$ "	5'-3"	18.4*	5	8	4'-0"	18"	18"	1"	12 $\frac{3}{4}$ "	5'-3"	14*	7	8	4'-0"	13"	18"	1"	9"	5'-3"	11.9*
54"	4	9	4'-6"	18"	18"	1 $\frac{1}{4}$ "	13 $\frac{1}{4}$ "	5'-9"	18.4*	6	9	4'-6"	18"	18"	1 $\frac{1}{4}$ "	19 $\frac{3}{4}$ "	5'-9"	14*	7	9	4'-6"	14 $\frac{1}{4}$ "	18"	1 $\frac{1}{4}$ "	9"	5'-9"	13.7*

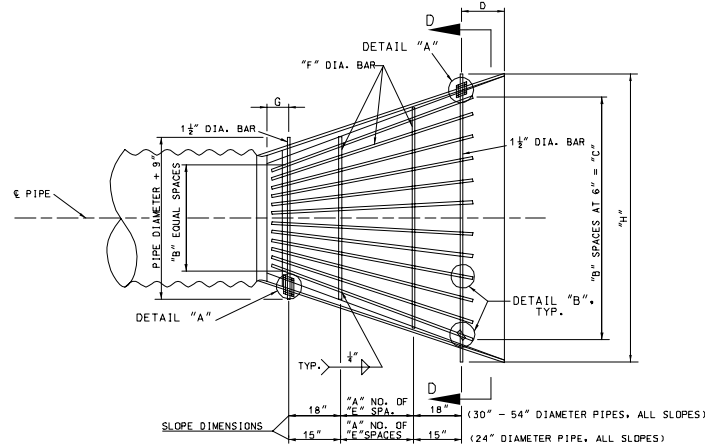
\* BAR GRATE SYSTEM IS NOT REQUIRED FOR DRAIN PIPE DIAMETER OF 21" OR LESS, FOR SINGLE PIPE INSTALLATIONS.



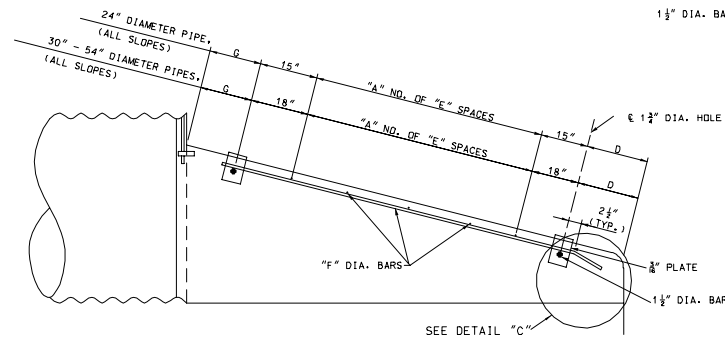
SECTION D-D



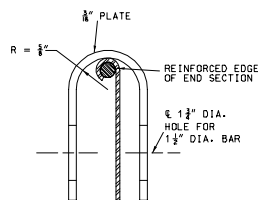
DETAIL C



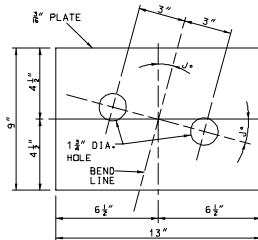
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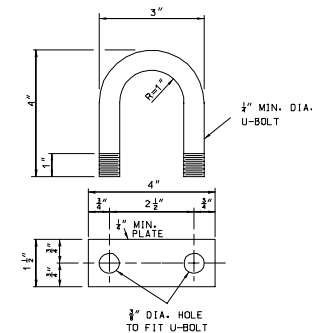
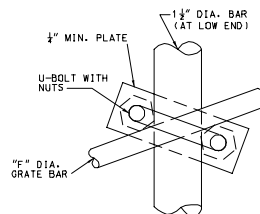
ELEVATION



DETAIL A  
BENT PLATE ANCHOR



DETAIL B  
U-BOLT ANCHOR



## GENERAL NOTES:

- ALL STEEL MATERIAL FOR BAR GRATE SYSTEM SHALL CONFORM TO THE REQUIREMENTS OF ASTM A575 GRADE 50/60 STEEL.
- ALL MATERIAL IN GRATE SYSTEM SHALL BE GALVANIZED.
- GALVANIZING SHALL BE DONE IN ACCORDANCE WITH ASTM A123.
- ALL MATERIALS, FABRICATION AND INSTALLATION OF OPTIONAL BAR GRATE SYSTEM USED IN LIEU OF SAFETY BAR SYSTEM SHALL BE INCLUDED IN CONTRACT UNIT PRICE BID FOR END SECTION (SAFETY SLOPE).

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION			
OPTIONAL BAR GRATE SYSTEM FOR SAFETY SLOPE END SECTION			
DATE: _____	EFFECTIVE: 04-01-2003	732.10E	2/2